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CAUSES OF THE RAPID FAILURE WHEAT YIELD IN
THE REGION OF SABAC IN 1964

- Yugoslavia -

[Following is a translation of an article by Engineer Milan Boskovic and Rados Maksimovic, Sabac Agricultural Station, in the Serbo-Croatian-language periodical Agrohemijska (Agronomy), No 11, 1964, pages 663-666.]

In a whole series of production years, i.e. from the time of introduction of high-yield wheat varieties, this year was the most promising for the high yields, particularly with densities where the agricultural measures of the highest quality have been applied. However, something happened that was the least expected; relatively the lowest yields have been obtained from the densities which promised the most. Rather often from the densities of the private sector and from smaller densities of the socialistic sector the yield was higher than from those which promised more.

Autumn conditions for wheat development in 1963, due to severe drought, were very poor. The winter, although with heavy snow cover and icy crust, has affected the wheat very favorably. It can be said that this was the only winter which had increased and not reduced the number of wheat plants in this climate. The spring precipitations were very favorably spread, which suitably affected wheat development; therefore upto 20 June wheat was promising a record yield, particularly with the densities where qualitative and timely, desirable agricultural measures have been applied. However, on 24 June the outlook changed suddenly for the worse, because a thermal shock occurred. This phenomenon affected wheats seeded from the first of October to the end of November, which have attained good formations.

The damage occurred particularly on the following varieties: Leonardo, Etual, Bezostaja 1, and San Pastore, and humidity and heat shock which occurred on 20, 21 and 22 June, i.e. during the transition from the milky into the golden wheat maturity. The reasons for the heat shock is the concurrence of the high air temperature with the relatively high humidity. Temperatures on these days in the shade varied from 30.2-33.2C, so that the temperature in the open field must have been 40° and perhaps more. Relative humidity at 2 m height, also in the shade, varied in noon measurements from 41 to 63%, and the average during those days varied between 80 and 83%. Relative humidity for the number of past years on Kopaonik was 78%, and that area is known in Serbia as having in June the highest relative humidity. Relative humidity in the wheat zone must have been much higher than shown, due to the great wheat density, and more so because it was taken at higher elevation where air movements are greater.

What happened under these conditions? The answer is an easy one based on known facts which negatively affected the plant life. High air temperature brought the air humidity to a state of hot steam, which paralyzed the nutritional apparatus of the wheat, which caused immediate stopping of all functions concerning transformation and movement in the useful direction of nutrients inside the plant. It is known that the nutritional apparatus of spring wheats is paralyzed at 38-40°C. When the relatively high air humidity and the fact that humid heat is much more injurious to the plants than dry heat are added to it, then the stated fact is more obvious and sure.

The paralysis of the nutritional apparatus has brought about the following:

All movements inside the plant in useful direction stopped;

Organic matters moving through the plant in the direction of the grain stopped in the sections where they happened to be when the paralysis of the apparatus occurred.

Mineral elements, built into the plant's organic matters, also did not reach the grain, but remained where they were at the time of shock.

Mineral elements, in preponderantly ionic form in the plant, after paralysis of the nutritional apparatus, changed the direction of their movement, and mostly returned to the soil or were washed through the leaves down to the soil.

This is clearly shown from the analysis of various sections of the plants, performed in the laboratory.

The attached data illustrate the following:

During vegetation, the plant takes a sufficient quantity of elements for the formation of a high yield.

The grains of the plants which suffered the shock regularly are deficient in all three analyzed elements as compared with a normal plant.

Nitrogen and Phosphorus, elements in the plant mainly built in organic compounds, remained in the sections of the plant where they happened to be during the physiological disturbance, caused by high relative air humidity and relatively high temperature, so they could not reach the grain.

Nitrogen remained mainly in the stalk of the injured plant, and to a lesser degree in the chaff.

Phosphorus remained partly in the stalk, but mostly in the leaves and in the chaff.

Potassium, an element mainly in ionic form in the plant, therefore very mobile, in great part returned to the soil or was again washed down into the soil from all sections of the plant, but mainly from chaff and leaves. The loss of this element was 30 and even more than 50% from certain sections of the plants, excluding the stalk.

The small content of nitrogen in the damaged wheat grain represents a certain guarantee that we do not have here some partial disturbance of the plant, which would cause a difficult nutrition and water supply, but a sudden interruption of the physiological functions of the plant. The sudden interruption of these functions of the plant is confirmed also by the fact that the nitrogen-containing compounds, during the conditions of difficult plant water supply, reach the grain easier than all other compounds in the plant; so they are percentagewise more numerous with

plants having a difficult water supply then with normally developed plants. With the wheat normally matured this year the opposite happened.

Table of Contents in Various Sections of the Normally Matured Wheat Plant and Plants Affected By the Heat Shock

a) Nazimenovanje	b) Koren	c) Stablo	d) List	e) Pleva	f) Zrno
g) Azot %					
1) Pšenica normalno sazrela	—	0.058	0.560	0.198	0.700
2) Pšenica pretrpele udar	0.232	0.168	0.560	0.224	0.616
h) Fosfor u %					
3) Normalno sazrele biljke	—	0.11	0.25	0.16	0.76
4) Biljke pretrpele udar	0.13	0.12	0.35	0.23	0.71
i) Kalijum %					
5) Normalno sazrele biljke	—	0.80	0.88	0.60	0.58
6) Biljke pretrpele udar	0.60	0.60	0.58	0.28	0.52

[Legend:] a) Name; b) Root; c) Stalk; d) Leaf; e) Chaff; f) Grain; g) Nitrogen; h) Wheat normally matured; i) Wheat after shock; j) Phosphorus; k) Plants normally matured; l) Plants after shock; m) Potassium.

The above data are given also in relative figures for better presentation and better understanding of analysis made.

a) Nazimenovanje	b) Stablo	c) List	d) Pleva	e) Zrno
f) Azot u %				
9) Normalno sazrele biljke	100	100	100	100
10) Biljke pretrpele udar	300	100	120	88
h) Fosfor u %				
11) Normalno sazrele biljke	100	100	100	100
12) Biljke pretrpele udar	109	140	143.7	93
i) Kalijum u %				
13) Normalno sazrele biljke	100	100	100	100
14) Biljke pretrpele udar	70.5	66	46.6	90

[Legend on following page]

[Legend:] a) Name; b) Stalk; c) Leaf;
d) Chaff; e) Grain; f) Nitrogen; g)
Plants normally matured; h) Plants after
shock; i) Phosphorus; j) Potassium.

The relatively much higher yield failure on great densities of wheat plants than on smaller densities occurred for the following reasons:

On greater densities there was regularly a relatively higher air humidity present.

The opposite, lesser relative air humidity was present on smaller densities.

The higher relative air humidity impaired almost completely all plant evaporation on greater densities, while on the smaller densities the evaporation was always possible.

The evaporation possibility was much smaller per surface unit with high plant density than with lower plant densities, while per plant the difference was much greater to the advantage of smaller densities.

The plants are cooled by evaporation, and higher densities did not offer such a possibility, therefore they had to succumb to the heat shock. Lesser densities, however, were not so drastically damaged because they exploited more space per plant, and also higher evaporation possibility.

Conclusion

The main cause of the wheat yield failure in 1964 was the heat shock, which occurred on 20, 21 and 22 of June.

The thermal shock was created by the relatively high humidity and high temperature of the air.

The high agricultural technique has positively affected wheat development this year.

This is corroborated by the fact that plants cared for with a high agricultural technique until 20 of June had the prospect of a record production. As a proof there is visual appearance and analytical data showing that the necessary nutrients for a high yield have reached the plant.

As an extreme, the month of June is very rare; it had not occurred since 1925, so wheat remains a prospectively well-performing crop with the present assortment.

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